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ABSTRACT

A study was conducted for additional support of the view that bridging--drawing inferences to relate a sentence to a preceding sentence--occurs during reading rather than at the time of testing. Subjects were 88 third and 67 fifth grade students whose reading proficiency was measured by performance on the Metropolitan Achievement Test. The bridging text items consisted of two source sentences to be connected by a bridge selected from three alternatives. Twenty-six items for each of three bridging types were constructed. The resulting correlation between bridging and reading proficiency confirmed the hypothesis that bridging occurs during reading. Given the fact that instances requiring certain kinds of bridging are frequent even in early reading materials, the hypothesis that bridging is performed during reading rather than during testing implies that a good reader should also be proficient at bridging. This was also confirmed. The hypothesis that the abilities employed in bridging involving pragmatic reasoning and in bridging involving logical reasoning would differ was not supported. (Test results are appended in two tables.) (HTH)

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# Bridging and Reading Proficiency

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## Abstract

Bridging is the kind of inferencing necessary to relate a sentence to a previously occurring sentence. It was hypothesized that bridging is frequently used during reading. Support for this hypothesis was found in the experimental finding that bridging proficiency was significantly correlated with reading proficiency in third and fifth grade students. A second hypothesis that different abilities are involved in bridging according to whether a pragmatic or logical inference was involved was not supported by the data.

## Introduction

Numerous studies have been undertaken during the last decade to demonstrate that comprehension of text involves drawing inferences. Most of these studies leave open the possibility that the inferences were drown not at the time of reading but at the time of testing. The present study seeks additional support for the view that inferences are, in fact, drawn during reading at least when the inferences are drawn to relate a sentence to a preceding sentence. Drawing this kind of inference is called bridging.

## Background

A number of years ago there appeared in Reading Research quarterly an article by Blachowicz (1977-78) in which she reviewed some of the psycholinguistic experiments supporting the constructivist hypothesis and then added support from her own experiment with school children. The constructivist hypothesis maintains that comprehension of a text consisting of more then one sentence entails not merely making semantic interpretations of the individual sentences but also drawing inferences that combine these interpretations into a whole (Bransford, Barclay, & Franks,1972). The supportive evidence for this hypothesis in the experiments reviewed by Blachowicz was the finding that when subjects are asked whether a certain sentence had occurred in some passage

which they heard a few minutes before (recognition recall), there is a greater tendency for subjects to err in making this decision for a sentence which is an implication of one or more sentences in the passage. To take an example from Blachowicz, a short paragraph like:

> The birds sat on the branch.
> A hawk flew over it.
> The birds were robins.

is presented orally with nine other paragraphs of the same length. In the test of recognition recall, most errors were made in the case of the true inference, saying that it had occurred when in fact it had not. Thus more errors occurred in the case of A hawk flew over the birds., than in the case of a true statement The birds sat on a branch., a false statement A hawk flew under it., or a false inference A hawk flew under the birds.

For investigators interested in subprocesses of reading these results obtained by the recognition memory task raise an important question: did the subjects in experiments like this draw their inferences while reading (the inference-at-comprehension hypothesis) or during testing (the inference-at-retrieval hypothesis)? The results of several studies support the inference-at-comprehension hypothesis, e.g., Haviland & Clark, 1974; Keenan & Kintsch, 1974; Monaco & Harris, 1978; Singer, 1979. The Haviland and Clark study is especially interesting since it dealt with a kind of inferencing which is quite common in reading and was

given the name of bridging (Clark, 1975). Haviland & Clark (1974) displayed pairs of sentences like:

(1) We got some beer out of the trunk.
The beer was warm.

Each sentence of the pair was presented separately. Subjects (college students) were instructed to press a button as soon as they understood each sentence. While some subjects received the above pair of sentences, another group of subjects received the following pair:

(2) Andrew was especially fond of beer.
The beer was warm.

Haviland and Clark correctly hypothesized that the time to understand the second sentence (the target sentence) would be less in pairs like (1) than in pairs like (2). This hypothesis was based on their Given-New Strategy, according to which comprehension requires finding the antecedent for any Given information, i.e., any information which the reader is assumed to know. In the target sentence of both pairs given above, the word the indicates that the reader should know of some particular beer. In the first pair of sentences, the antecedent for the beer is the some beer (gotten out of the trunk). Hence finding the antecedent requires little time in the first pair. In the second pair of sentences, however, the generic beer in the first sentence cannot be taken as the antecedent for the beer in the target sentence. The necessity for drawing an inference like Andrew helped himself to some beer. containing

a proper antecedent resulted in a longer comprehension time for targets in pairs like (2). This drawing of an inference to relate a sentence to a preceding one is called bridging. As one studies Clark's (1975) taxonomy of bridging, it becomes obvious that several of the types of inferencing he calls bridging must occur frequently during reading. Here are some types Clark recognizes:

Identity. 1. I met a man in the park. 2. The man told me a story. Bridge: The man in sentence 2 refers to the same person as a man in sentence 1.

Set Memberships. 1. I met two people yesterday. 2. The woman told me a story. Bridge: One of the two people was a woman.

Necessary Parts. 1. I looked into the room. 2. The ceiling was very high. Bridge: The room had a ceiling.

Optional Roles. 1. John died yesterday. 2. The murderer got away. Bridge: John was murdered.

## The Experiment

The following investigation was undertaken as an additional demonstration that bridging is an integral part of the reading process. A preliminary study of bridging in basal readers carried out by a Lehigh University graduate student, Barbara Kerico, showed that bridging is called for even in early reading. Reasoning that if this were indeed the case, we would find good readers even in the ele-

mentary grades to be better at bridging than poor readers, we prepared an experiment to test the hypothesis that there is a significant correlation between reading and bridging proficiencies. There was a second hypothesis of interest to us; namely, that the abilities that are involved in bridging requiring logical reasoning are different from those involved in bridging requiring pragmatic reasoning. Pragmatic reasoning depends upon the world experience of the subject while logical reasoning depends upon the ability to follow certain semantic rules. Two of the bridging types employed in the present study, inducible parts and missing events, depend upon pragmatic reasoning, i.e., reasoning based on the world experience of the subjects. The third type, concurrence, depends upon logical reasoning cued by words like too, either, again. If the hypothesis is correct, we would expect that the two pragmatic types would be more closely correlated with each other than either would be with concurrence bridging.

## Materials

The bridging test items consisted of two source sentences to be connected by a bridge which was to be selected from three alternatives presented immediately after the source sentences. For example:

Inducible Parts

S1 Mrs. Jones went to the market.

S2 She picked the ripest fruit.

Alternatives:

a. Mrs. Jones likes fruit.

b. There was fruit at the market. (Correct)

c. Fruit ripens at the market.

Missing Events

S1 Joe cut up apples.

S2 Now the pie plate was full.

Alternatives:

a. Joe put the apple slices in the pie plate. (Correct)

b. Joe likes to bake apple pies.

c. Apple pies are baked in pie plates.

Concurrence

S1 Diane had tickets for last night's show.

S2 She is going to see the show again tonight.

Alternatives:

a. Diane saw the show last night. (Correct)

b. Tickets are hard to get.

c. Diane's friends went to see the show too.

We constructed 26 test items for each of the three bridging types and pretested them with 30 third grade and 30 fifth grade students (for list of test items, see Philbin, 1981). The same testing procedure was used with these subjects as later with the experimental subjects (see below). The index of discrimination (the corrected item-total correlation within each type) was calculated for each item (Hull & Nie, 1981), and the 13 items in each

bridging type with the lowest indices was dropped. This left 13 test items in each of the three bridging types for the experiment. The reliability (Cronbach's alpha) for these remaining items was: inducible parts .75, missing events .80, concurrence .82.

Testing Procedure

Reading proficiency was measured by performance on the Metropolitan Achievement Test (1970). This test was administered by the school in the same year the bridging test was administered.

In order for the correlation between the reading and bridging tests to have any validity, it was necessary to minimize the role of reading proficiency in the bridging test. This was accomplished by having the test administrator (Philbin) read each bridging item, the source sentences and the three alternative responses twice while the subjects were looking at the page of the test booklet on which the bridging item was printed. The subjects merely had to check the correct alternative.

Subjects

The subjects for the study consisted of 88 third and 67 fifth grade students. These subjects were not used in pretesting the materials. Of the third grade subjects, 47

were males and 41 were females. Of the 67 fifth grade subjects, 31 were male and 36 were female.

Experimental Results

The means and standard deviations for bridging and reading performance are given in Table 1.

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Insert Table 1 around here

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A two-way analysis of variance was done for each of the bridging types separately to test for the effects of grade, sex and their interaction. Only the differences in bridging proficiency due to grade turned out statistically significant. The following F ratios were obtained: inducible parts: grade, $F(1,151)=15.15$ ($p<.001$); sex, $F(1,151)=.77$ ($p<.381$); grade x sex $F(1,151)=1.42$ ($p<.235$); missing events: grade, $F(1,151)=10.54$ ($p<.001$); sex, $F(1,151)=3.02$ ($p<.084$); grade x sex, $F(1,151)=.01$ ($p<.905$); concurrence: grade, $F(1,151)=5.81$ ($p<.01$); sex, $F(1,151)=2.06$ ($p<.15$); grade x sex, $F(1,151)=.02$ ($p<.88$)

No statistical test was performed for the differences among the means for the three bridging types since we cannot assume that the bridging items we have written for our test are random samples with regard to difficulty. It is reasonable, however, to assume that the samples are repre-

sentative of their populations in terms of the abilities the bridging types involve.

To test our two hypothesis we computed zero-order Pearson product-moment correlations between the bridging types and reading proficiency as well as between the pairs of bridging types. The results are shown in Table 2.

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Insert Table 2 around here

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All the correlation coefficients shown in the table are statistically different from zero (by two-tailed t-tests) with $p<.001$. Thus the hypothesis that there is a significant relationship between bridging and reading proficiency is confirmed.

To test the hypothesis that concurrence bridging (logical inference) involved different abilities from those involved in inducible parts or missing events (pragmatic inference), we examined the following differences: 1. correlation (concurrence: inducible parts) - correlation (inducible parts: missing events); 2. correlation (concurrence: missing events) - correlation (inducible parts: missing events); 3. correlation (concurrence: inducible parts) - correlation (concurrence: missing events). Using a z-test for dependent samples (Glass & Stanley, 1973) we found none of the differences was significant at the .05 level. Thus the data failed to support this hypothesis.

## Conclusions

Given the fact that instances requiring certain kinds of bridging are frequent even in early reading materials, the hypothesis that bridging is performed during reading rather than during testing implies that a good reader should also be proficient at bridging. The sizeable correlations between reading and bridging proficiency obtained in this experiment testifying to the truth of this implication give some measure of support to the hypothesis.

The hypothesis that the abilities employed in bridging involving pragmatic reasoning and in bridging involving logical reasoning would differ was not supported. Further investigation into this problem would probably require a more sensitive experimental procedure, a procedure requiring the production of bridging with response time as the measure of proficiency.

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Table 1 Means and standard deviations on bridging and reading proficiency

| Grade 3 | Male | (N=47) | Female | (N=41) |
|---|---|---|---|---|
| Inducible Parts | 8.49 | (2.56) | 8.37 | (2.75) |
| Missing Events | 8.77 | (2.72) | 9.54 | (2.72) |
| Concurrence | 6.85 | (2.71) | 7.56 | (2.93) |
| Reading | 27.98 | (8.81) | 30.59 | (8.78) |
| **Grade 5** | **Male** | **(N=31)** | **Female** | **(N=36)** |
| Inducible Parts | 9.55 | (2.26) | 10.36 | (1.85) |
| Missing Events | 10.16 | (2.29) | 10.83 | (2.31) |
| Concurrence | 8.00 | (2.89) | 8.58 | (2.55) |
| Reading | 28.61 | (8.48) | 31.17 | (6.79) |

Table 2 Zero-order correlations between bridging and reading

| Grade 3 (N=88) | Missing Events | Concurrence | Reading |
|---|---|---|---|
| Inducible Parts | .65 | .62 | .47 |
| Missing Events | | .68 | .52 |
| Concurrence | | | .63 |
| **Grade 5 (N=67)** | | | |
| Inducible Parts | .56 | .46 | .52 |
| Missing Events | | .61 | .46 |
| Concurrence | | | .55 |

$p < .001$ for all correlations